incorporate the proposed limitations discussed in the interview. No new matter has been added.

35 U.S.C. §103 Rejections

Claims 1-4, 8-11, 13-15, 67-69, and 71 have been rejected under 35 U.S.C. §103(a), as being unpatentable over Yoon et al. (U.S. Patent No. 5,670,056). In Paragraph 2 of the Official Action, the Examiner, with reference to col. 2, line 21 through col. 6, line 32 of Yoon et al., asserts that "the claims of the pending application differ from Yoon et al. by reciting specific steps for increasing the hydrophobicity of the particular material." The Examiner argues, however, that "the addition of a combination of non-ionic surfactants and hydrophobic polymers as disclosed in Yoon et al. would appear to increase the hydrophobicity of the particulate material as in the instant process." In addition, in Paragraph 13 of the official action, the Examiner argues that "a combination of non-ionic surfactants and hydrophobic polymers as disclosed in Yoon et al. would appear to suggest that these materials could be added in a two-step hydrophobization and increase the hydrophobicity of the particulate material as in the instant process." Accordingly, the Examiner asserts that it would have been obvious to the one skilled in the art to modify the process of Yoon et al. by utilizing the recited steps for increasing the hydrophobicity of the particulate material, to aid in dewatering the slurry. Applicant respectfully traverses this rejection.

The specific steps noted by the Examiner refer to the two-step hydrophobization process described in detail at page 17, 3rd paragraph of the Specification:

> In the instant invention, contact angle is increased by using low HLB surfactants in conjunction with light hydrocarbon oils and short-chain alcohols. The driving force for the adsorption mechanism is the hydrophobic attraction. Since the hydrophobic attraction exists only between two hydrophobic entities, it is necessary that the particles to be dewatered be rendered hydrophobic prior to or during the addition of the low HLB surfactants. For hydrophilic particles such as untreated silica and clay, they are hydrophobized by adsorbing appropriate surfactants on the surface. After the initial hydrophobization step, a low HLB surfactant can be added to further enhance the hydrophobicity for improved dewatering. The surfactants that can be used for the initial hydrophobization step are usually high HLB surfactants whose polar head groups can interact with the surface via coulumbic attraction, chemical bonding, electron-transfer, or acid-base interactions, while their non-polar tails are directed toward the aqueous phase. (emphasis added).

Each of the presently pending claims requires a two-step process. In particular, independent claim 1 has been amended to incorporate limitations from claims 3 and 14, and stipulates a two-step hydrophobization process wherein a high HLB surfactant is added prior to a low HLB surfactant. Independent claim 67 has been amended to incorporate limitations from claim 3, and stipulates a two-step hydrophobization process wherein a hydrocarbon oil is added prior to a low HLB surfactant. As amended, these claims specifically require an initial hydrophobization step using a high HLB surfactant (for a hydrophilic material) or hydrocarbon oil (for a hydrophobic material), followed by another hydrophobization step in which a low HLB surfactant is used.

The claimed process is distinctly different from the method of using a combination of non-ionic surfactant and hydrophobic polymer, as described by the Examiner in reference to Yoon et al. It is well-known that non-ionic surfactants usually have low HLB numbers, and are not efficient in rendering hydrophilic mineral hydrophobic. Moreover, a hydrophobic polymer is another type of non-ionic surfactant.

As such, the combination of a nonionic surfactant with a hydrophobic polymer as disclosed in Yoon et al. is a combination of two nonionic surfactants. Clearly, the claimed dewatering process based on the two-step hydrophobization step could not have been obvious to the one skilled in the art at time the invention was made in view of the teaching from Yoon et al. to combine nonionic surfactants, i.e. a nonionic surfactant and a hydrophobic polymer.

With respect to the claimed invention, the driving force for the adsorption of the low HLB surfactants (which constitutes the second hydrophobization step) was hydrophobic attraction, as noted in the section of the Specification quoted above. The non-ionic surfactants (or low HLB surfactants), which are hydrophobic, would not adsorb readily on the surface of hydrophilic particulate materials. Only when the hydrophilic material has been hydrophobized with a high HLB surfactant first, will a low HLB surfactant can readily adsorb on the surface and, hence, further increase the hydrophobicity.

On the contrary, Yoon et al. state the following *(col. 4 line 38)*:

> This process will be useful in dewatering a wide variety of particulate material including coals, clays, sulfides, phosphates, metals, minerals, or other particles.

Most of these materials, with the exception of some types of coals, are hydrophilic. Thus, Yoon et al. teaches that their process works without the first hydrophobization step, which is distinct from the specific steps disclosed in the pending application.

Moreover, Yoon et al. states in col. 4 line 49 that "The hydrophobizing reagent must be water soluble or water dispersable (e.g., an emulsion) in order to enable it to be

applied to the surface of the particles being dewatered." The nonionic surfactants with low HLB numbers are mostly water insoluble. Therefore, they are used in conjunction with "organic solvents" as required by independent claims 1 and 67. In fact, dependent claims 13, 72 and 73 delineate specific organic solvents.

The benefit of implementing the two-step hydrophobization process has been given in Examples 19 and 20. In Example 19, dewatering tests were conducted on a silica sample (a well-known hydrophilic material) using sorbitan monooleate, a non-ionic surfactant whose HLB number is 2.2. Using this surfactant alone, the moisture of the silica sample was reduced from 26.1% to 20.7-22.6% range. Using the two-step hydrophobization process disclosed in the pending application, the moisture was reduced to 8.4-11.2% range. The silica sample was hydrophobized first with dodecylammonium hydrochloride, a high HLB surfactant, and subsequently with the sorbitan monooleate. In Example 20, similar examples were given with clay, another well-known hydrophilic mineral. These two examples clearly demonstrate that the two-step hydrophobization process is advantageous over the method described by Yoon et al. The theoretical reasons for the advantages are given in detail in the Specification.

The Applicant has amended independent claims 1 and 67 to more clearly describe the two-step hydrophobization. Independent claim 1, and the claims that depend therefrom, are directed to a process for dewatering hydrophilic materials. Independent claim 67, and the claims that depend therefrom, are for dewatering hydrophobic particles. The first step in claim 1 requires adding a high HLB surfactant, and the first step in claim 67 requires adding a hydrocarbon oil. The second step in claims 1 and 67 requires adding

a low HLB surfactant dissolved in an organic solvent.

Concerning claim 67, the Examiner pointed out that the coal dewatered in Yoon et al. appears to be hydrophobic. Applicant agrees to this view. However, there exists an important distinction between the teachings of Yoon et al. and the invention of claim 67. Claim 67 requires treating the material with "hydrocarbon oils" as an initial hydrophobization step and then adding a low HLB surfactant dissolved in an inorganic solvent in a second hydrophobization step. In Yoon et al., the coal dewatering tests were conducted without the first hydrophobization step just before the dewatering tests.

Yoon et al. simply fails to teach or suggest, either explicitly or implicitly, a two-step hydrophobization, as required by independent claims 1 and 67. Claims 2, 8, and 10-15 depend, either directly or ultimately, from claim 1, and claims 68-71 depend, either directly or ultimately from claim 67. As such, Applicant respectfully requests that the Examiner withdraw the rejection of claims 1-4, 8-11, 13-15, 67-69, and 71 under 35 U.S.C. §103(a) in view of Yoon, et al. upon reconsideration.

Claims 12 and 70 have been rejected under 35 U.S.C. 103 (a) as being unpatentable over Yoon et al. in view of Wang et al. (U.S. Patent No. 4,210,531). The Examiner asserts that:

> the Claims differ from Yoon et al. by reciting that the surfactant is blended with a specific oil. Wang et al. disclose (see col. 2 line 27 through col. 4 line 24) that it is known in the art to utilize a combination of surfactant and recited oils, to aid in dewatering mineral slurry concentrates. It would have been obvious to one skilled in the art to modify the process of Yoon et al. by utilizing a surfactant blended with the recited oils in view of the teaching of Wang et al., to aid in dewatering the slurry.

Claims 12 and 70 require a two-step process using a high HLB surfactant in the

first step and a low HLB surfactant in the second step, wherein the low HLB surfactant is blended with "vegetable, fish, or animal oil." Since claims 12 and 70 depend from claims 1 and 67, they are in a condition for allowance for the reasons adduced above. Moreover, the Applicant has discovered that combined use of these oils required by claims 12 and 70 and low HLB surfactants showed synergistic effects, as disclosed in Example 18. Such combination provides significant cost savings.

Wang et al. fails to teach the claimed two-step hydrophobization. Instead, Wang et al. teaches that one can use a combination of a polyacrylamide flocculant, anionic surfactant, and water insoluble organic liquid. Anionic surfactants are high HLB surfactants. Furthermore, polyacrylamide polymers are hydrophilic.

In complete contrast, claims 12 and 70 require the use of a low HLB surfactant blended with a vegetable, fish or animal oil in a second step of a two-step hydrophobization process. There is simply nothing in Wang or Yoon et al. that teaches or suggests such a process. For this additional reason, Applicant respectfully requests that the Examiner withdraw the rejection of claims 12 and 70 under 35 U.S.C. §103(a) in view of Yoon et al. and Wang upon reconsideration.

In view of the foregoing remarks, all of the presently pending claims are believed to be in condition for allowance. A marked-up version of the claims showing the changes made is attached. Entry of the present amendment and allowance of all of the presently pending claims is, therefore, respectfully requested.

In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account No. 50-2121.

Respectfully submitted,

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Marked Up Copy of Claims Showing Changes Made

USSN 09/327,266; Amend B

October 15, 2002

Claims 3-4, 9, and 18-19, 22, 25-27, 30-32, 35-36, and 39-66 have been cancelled without prejudice.

New claims 72-73 have been added.

Claims 1, 2, 8, 12, 14, 15, 67 and 68 have been amended as follows:

1. (Twice Amended) A process for dewatering a slurry of hydrophilic particulate material comprising:

   i) hydrophobizing [increasing the hydrophobicity of] said material using a high hydrophile-lipophile balance (HLB) surfactant;

   ii) adding a nonionic surfactant of [low hydrophile-lipophile balance (]HLB[)] number less than 15 dissolved in at least one organic solvent;

   iii) agitating said slurry to allow for said nonionic surfactant to adsorb on the surface of said material so that its hydrophobicity is further increased; and

   iv) subjecting the agitated slurry containing said material to a mechanical method of dewatering.

2. (Twice Amended) The process of claim 1 wherein said particulate mat[t]erial comprises particles of less than 2 mm in size.

8. (Twice Amended) The process of claim 1 wherein said hydrophobizing [increasing the hydrophobicity] step comprises rendering [increasing the hydrophobicity of] said material hydrophobic, so that its [to exhibit a] water contact angle is increased to less than 90°.

12. (Twice Amended) The process of claim 11 wherein said low HLB surfactant is blended with a vegetable, fish or animal oil containing triacylglycer[ols]ides and the biodiesel derived from these oils.

14. (Amended) The process of claim 1 [4] wherein said high HLB surfactant [or collector comprises a high HLB surfactant having] has a polar head configured to interact with the surface of said particulate material.

15. (Twice Amended) The process of claim 1 [4] wherein said high HLB surfactant is [collectors are] selected from the group consisting of[:] thiols and xanthates for sulfide minerals.

67. (Twice Amended) A process for dewatering a slurry of hydrophobic particulate material comprising:

i) adding hydrocarbon oils to increase the hydrophobicity of said hydrophobic particulate material;

ii) adding a nonionic surfactant of [low] hydrophile-lipophile balance (HLB) number less than 15 dissolved in at least one organic solvent;

iii) agitating said slurry to allow for said nonionic surfactant to adsorb on the surface of said material so that its hydrophobicity is further increased; and

iv) subjecting the agitated slurry containing said material to a mechanical method of dewatering.

68. (Twice Amended) The process for claim 67 wherein said particulate mat[t]erial comprises particles of less than 2mm in size.